

What is claimed is:

- 1 1. A method of adjusting symbol timing in a first communications device, the
2 method comprising:
3 determining a receiver symbol timing adjustment to be made to adjust receiver
4 symbol timing in said first communications device to synchronize receiver symbol timing
5 to the symbol timing of a second communications device; and
6 adjusting the symbol timing of a transmitter in said first communications device
7 as a function of said determined receiver symbol timing adjustment.
- 1 2. The method of claim 1, wherein said receiver symbol timing adjustment indicates
2 that symbol timing should be adjusted by an amount corresponding to D digital signal
3 samples.
- 1 3. The method of claim 2, wherein the first communications device is a wireless
2 terminal.
- 1 4. The method of claim 3, wherein the second communications device is a base
2 station.
- 1 5. The method of claim 3, further comprising:
2 adjusting the symbol timing of a receiver included in said first
3 communications device to delay said receiver symbol timing by D samples; and
4 wherein the step of adjusting the symbol timing of said transmitter in said
5 first communications device includes adjusting the symbol timing of said transmitter
6 included in said wireless terminal to delay the transmission of symbols by D, or
7 substantially D, samples.

1 6. The method of claim 5, wherein delaying the transmission of symbols includes
2 the step of adding D samples to a symbol being transmitted by said transmitter thereby
3 increasing the duration of said symbol.

1 7. The method of claim 6, wherein the step of adjusting the symbol timing of said
2 transmitter includes the step of:
3 selecting one of a first or last symbol in a dwell to be used as said symbol to
4 which said D samples are added to adjust the symbol timing.

1 8. The method of claim 7, wherein the first symbol in a dwell is selected as said
2 symbol to which said D samples are added, the selected first symbol having N samples,
3 the step of adjusting the symbol timing further including:
4 copying D samples from the body of said first symbol and inserting the D copied
5 samples at the start of said symbol to produce a first symbol having N+D samples.

1 9. The method of claim 7, wherein the last symbol in a dwell is selected as said
2 symbol to which said D samples are added, the selected last symbol having N samples,
3 the step of adjusting the symbol timing further including:
4 copying D samples from the body of said first symbol and inserting the D copied
5 samples at the end of said symbol to produce a last symbol having N+D samples.

1 10. The method of claim 3, further comprising:
2 wherein the step of adjusting the symbol timing of said transmitter in said
3 wireless terminal includes adjusting the symbol timing of said transmitter included in said
4 first communications device to advance the transmission of symbols by D, or
5 substantially D, samples.

1 11. The method of claim 10, wherein advancing the transmission of symbols includes
2 the step of removing D samples from a symbol being transmitted by said transmitter
3 thereby decreasing the duration of said symbol.

1 12. The method of claim 11, wherein the step of adjusting the symbol timing of said
2 transmitter includes the step of:
3 selecting the first or last symbol in a dwell to be used as said symbol from which
4 said D samples are to be removed to adjust the symbol timing.

1 13. The method of claim 11, wherein the step of adjusting the symbol timing of said
2 transmitter includes the steps of:
3 selecting the first symbol in a dwell to be used as said symbol from which said D
4 samples are to be removed to adjust the symbol timing, the first symbol including N
5 symbols beginning with a K sample cyclic prefix; and
6 deleting D samples from the start of the K sample cyclic prefix of said first
7 symbol to produce a first symbol having N-D samples, where N, D and K are positive
8 non-zero integers.

1 14. The method of claim 11, wherein the last symbol in a dwell is selected as said
2 symbol from which said D samples are to be removed, the selected last symbol having N
3 samples, the step of adjusting the symbol timing further including:
4 deleting D samples from the end of said last symbol to produce a last symbol
5 having N-D samples, where N and D are positive non-zero integers.

1 15. The method of claim 2, wherein said step of determining a receiver symbol timing
2 adjustment includes:
3 receiving a symbol timing correction signal transmitted from said second
4 communications device.

1 16. The method of claim 2, further comprising:
2 adjusting receiver symbol timing by D signal samples.

1 17. A mobile communications device, comprising:
2 a clock;

3 a receiver symbol timing control circuitry coupled to said clock for
4 determining a receiver symbol timing adjustment used to synchronize receiver symbol
5 timing to the symbol timing of a broadcast signal;

6 a transmitter symbol timing control circuitry coupled to said clock and to
7 said receiver symbol timing control circuitry, the transmitter symbol timing control
8 circuitry receiving symbol timing adjustment information from said receiver symbol
9 timing adjustment circuitry and making transmitter symbol timing adjustments in an
10 amount and direction which is the same, or substantially the same, as receiver symbol
11 timing adjustments made by said receiver symbol timing control circuitry.

1 18. The mobile communication device of claim 17, wherein said transmitter symbol
2 timing control circuitry includes:

3 means for selecting a symbol to be transmitted to be lengthened or
4 shortened prior to transmission to implement said symbol timing adjustment.

1 19. The mobile communication device of claim 18,

2 wherein said means for selecting a symbol selects the first or last symbol
3 in a dwell to be lengthened or shortened,

4 the symbol timing control circuitry further including:

5 copy circuitry for performing a cyclic copy to add copied samples to said
6 selected symbol to be transmitted when said transmitter symbol timing is to be delayed;
7 and

8 deleting circuitry for deleting samples from said selected symbol to be
9 transmitted when said transmitter symbol timing is to be advanced.

1 20. The mobile communications device of claim 19, wherein said symbols are
2 frequency division multiplexed symbols, the mobile communication device further
3 comprising:

4 an antenna for transmitting symbols including a symbol whose duration has been
5 changed by one of said copy circuitry and said deleting circuitry.

1 21. A communications system, comprising:

2 a first base station, the first base station including:

3 i) a base station clock,

4 ii) a receiver circuit for receiving symbols coupled to said clock,

5 the receiver circuit having fixed symbol timing; and

6 iii) a transmitter circuit for transmitting symbols coupled to said

7 clock, the transmitter circuit having fixed symbol timing; and

8 a first mobile communications device for receiving symbols broadcast by said
9 first base station and transmitting symbols to said first base station, the mobile
10 communication device including:

11 i) a receiver circuit for receiving signals from said first base
12 station, the receiver circuit including receiver symbol timing adjustment
13 circuitry for adjusting receiver symbol timing as a function of a signal
14 received from said first base station; and

15 ii) a transmitter circuit for transmitting symbols to said first base
16 station, the transmitter circuit including transmitter symbol timing control
17 circuitry slaved to said receiver symbol timing adjustment circuitry, the
18 transmitter symbol timing control circuitry making adjustments to the
19 transmitter symbol timing which are the same or substantially the same as
20 the adjustments made by the receiver symbol timing adjustment circuitry
21 to the receiver symbol timing.

1 22. The system of claim 21, wherein the signal received from said first base station is
2 a timing control signal used to control the receiver circuit to make a symbol timing
3 correction.

1 23. The communication system of claim 21, further comprising:

2 a second mobile communications device for receiving symbols broadcast by said
3 first base station and transmitting symbols to said first base station, the mobile
4 communication device including:

5 i) a receiver circuit for receiving signals from said first base
6 station, the receiver circuit including receiver symbol timing adjustment
7 circuitry for adjusting receiver symbol timing as a function of a signal
8 received from said first base station; and
9 ii) a transmitter circuit for transmitting symbols to said first base
10 station, the transmitter circuit including transmitter symbol timing control
11 circuitry slaved to said receiver symbol timing adjustment circuitry, the
12 transmitter symbol timing control circuitry making adjustments to the
13 transmitter symbol timing which are the same or substantially the same as
14 the adjustments made by the receiver symbol timing adjustment circuitry
15 to the receiver symbol timing.

1 24. The system of claim 23, further comprising:

2 a second base station for transmitting symbols to the first and
3 second mobile communications devices;
4 wherein the receiver symbol timing adjustment circuitry of the first
5 mobile communication device includes means for independently determining symbol
6 timing adjustments to be made when processing symbols corresponding to each of the
7 first and second base stations; and
8 wherein the transmitter symbol timing control circuitry of the first
9 mobile communication device includes means for independently adjusting the symbol
10 timing of symbols transmitted to the first and second base stations, respectively, as a
11 function of the symbol timing adjustments determined to be made when processing
12 symbols corresponding to the first and second base stations, respectively.

1 25. The system of claim 23, wherein the transmitter included in said first base station
2 is an OFDM transmitter.

1 26. A method of making symbol timing adjustments in a communications device
2 including a transmitter which transmits multiple symbols in each of a plurality of dwells,
3 the method comprising the step of:

4 determining the number of samples by which the symbol timing is to be
5 advanced or delayed during a dwell;

6 increasing the number of samples in one of a first symbol and a last
7 symbol of said dwell by the determined number of samples when said symbol timing is to
8 be delayed during said dwell by the determined number of samples; and

9 decreasing the number of samples in one of the first symbol and the last
10 symbol of said dwell by the determined number of samples when said symbol timing is to
11 be advanced during said dwell by the determined number of samples.

1 27. The method of claim 26, wherein the number of samples in the remaining
2 symbols in the dwell which includes said one of the first symbol and the last symbol of
3 said dwell to which samples were added or removed to adjust symbol timing do not have
4 their number of symbols changed as part of making symbol timing adjustments.

1 28. The method of claim 26,

2 wherein said one of a first symbol and a last symbol of said dwell is said
3 first symbol, the first symbol including a cyclic prefix portion and a body portion; and

4 wherein increasing the number of samples in said first symbol includes:
5 copying samples from the body portion of said first symbol and inserting
6 the copied samples at the start of said first symbol thereby increasing the number of
7 samples in said first symbol.

1 29. The method of claim 26,

2 wherein said one of a first symbol and a last symbol of said dwell is said
3 first symbol, the first symbol including a cyclic prefix portion and a body portion; and

4 wherein decreasing the number of samples in said first symbol includes:
5 removing samples from the start of the cyclic prefix portion thereby
6 decreasing the number of samples in said first symbol.

1 30. The method of claim 26,

2 wherein said one of a first symbol and a last symbol of said dwell is said
3 last symbol, the last symbol including a cyclic prefix portion and a body portion; and
4 wherein increasing the number of samples in said last symbol includes:
5 copying samples from the body portion of said first symbol and
6 inserting the copied samples at the end of said first symbol thereby
7 increasing the number of samples in said first symbol.

1 31. The method of claim 26,

2 wherein said one of a first symbol and a last symbol of said dwell is said
3 last symbol; and
4 wherein decreasing the number of samples in said first symbol includes:
5 removing samples from the end of said last symbol thereby
6 decreasing the number of samples in said last symbol

1 32. A communications device, comprising:

2 a transmitter which transmits multiple symbols in each of a plurality of
3 dwells, the transmitter including:
4 means for determining the number of samples by which the symbol timing
5 is to be advanced or delayed during a dwell;
6 means for increasing the number of samples in one of a first symbol and a
7 last symbol of said dwell by the determined number of samples when said symbol timing
8 is to be delayed during said dwell by the determined number of samples; and
9 means for decreasing the number of samples in one of the first symbol and
10 the last symbol of said dwell by the determined number of samples when said symbol
11 timing is to be advanced during said dwell by the determined number of samples.

1 33. The device claim 32,

2 wherein said one of a first symbol and a last symbol of said dwell is said
3 first symbol, the first symbol including a cyclic prefix portion and a body portion; and
4 wherein said means for increasing the number of samples in said first
5 symbol includes:

6 means for copying samples from the body portion of said first symbol and
7 inserting the copied samples at the start of said first symbol to thereby increase the
8 number of samples in said first symbol.

1 34. The device of claim 32,

2 wherein said one of a first symbol and a last symbol of said dwell is said
3 first symbol, the first symbol including a cyclic prefix portion and a body portion; and

4 wherein said means for decreasing the number of samples in said first
5 symbol includes:

6 means for removing samples from the start of the cyclic prefix portion to
7 thereby decrease the number of samples in said first symbol.

1 35. The device of claim 32,

2 wherein said one of a first symbol and a last symbol of said dwell is said
3 last symbol, the last symbol including a cyclic prefix portion and a body portion; and

4 wherein said means increasing the number of samples in said last symbol
5 includes:

6 means for copying samples from the body portion of said first
7 symbol and inserting the copied samples at the end of said first symbol
8 thereby increasing the number of samples in said first symbol.

1 36. The device of claim 35,

2 wherein said one of a first symbol and a last symbol of said dwell is said
3 last symbol; and

4 wherein said means for decreasing the number of samples in said first
5 symbol includes:

6 means for removing samples from the end of said last
7 symbol thereby decreasing the number of samples in said last symbol.